[0007] In selecting reactants for use in a hydrogen generator, consideration may be given to the following: (a) stability during long periods of time when the hydrogen generator is not in use, (b) ease of initiation of a hydrogen generating reaction, (c) the amount of energy that must be provided to sustain the hydrogen generating reaction, (d) the maximum operating temperature of the hydrogen generating reaction, and (e) the total volume of hydrogen that can be produced per unit of volume and per unit of mass of the reactant(s).

[0008] Some hydrogen containing compounds can be heated to evolve hydrogen in a chemical decomposition reaction. Such thermal decomposition reactions, such as those of hydrides, can be advantageous over hydrolysis reactions because the yield of hydrogen is greater, it does not produce steam vapor that may have to be removed from the hydrogen gas, and freezing is not a concern.

[0009] In some systems using gas produced by a gas generator, it is desirable to produce the gas on an as-needed basis, thereby minimizing the need (and the volume) to store a large quantity of gas until needed. It can also be desirable to provide the reactants for the gas generator in a replaceable, low cost form. It can also be desirable to operate the gas generator at a low cost, with a minimum amount of energy required.

[0010] In view of the above, an object of the present invention is to provide a hydrogen generator that is easy and economical to manufacture and operate, has a user replaceable fuel unit containing a minimum number of components, requires minimal cleaning by the user, and can provide hydrogen gas in limited quantities as needed.

SUMMARY

[0011] The above objects are met and the above disadvantages of the prior art are overcome by a hydrogen generator and a fuel cell system including a fuel cell battery and a hydrogen generator as described herein.

[0011a] In one aspect, there is provided a hydrogen generator comprising: a housing including an access panel; an initiator assembly disposed in the housing and including one or more contact members; a compressible member having opposing first and second surfaces and within which the one or more contact members are disposed; and a fuel unit removably disposed in the housing adjacent the first surface of the compressible member, the fuel unit containing a hydrogen containing material that can release hydrogen gas when heated and an exothermic mixture that can react exothermically upon initiation by energy from the initiator assembly;

wherein:

when no fuel unit is disposed in the hydrogen generator, the compressible member is uncompressed, and the one or more contact members are at or below the first surface; when a fuel unit is disposed in the hydrogen generator, the compressible member is compressed such that the one or more contact members extend beyond the first surface to make thermal contact with the fuel unit; and

energy from the initiator assembly is conducted by the one or more contact members to corresponding one or more quantities of the exothermic mixture to initiate an exothermic reaction therein, thereby providing heat for the release of hydrogen gas from the hydrogen containing material.

[0012] Accordingly, one embodiment of the present disclosure is a hydrogen generator including: a housing including an access panel; an initiator assembly disposed in the housing and including one or more contact members; a compressible member having opposing first and second surfaces and within which the one or more contact members are disposed; and a fuel unit removably disposed in the housing adjacent the first surface of the compressible member, the fuel unit containing a hydrogen containing material that can release hydrogen gas when heated and an exothermic mixture that can react exothermically upon initiation by energy from the initiator assembly. When no fuel unit is disposed in the hydrogen generator,

energy is provided to the initiator assembly from an energy source;

- the compressible member includes hydrogen flow channels in its first surface; and
- the access panel is moveable to provide access to the hydrogen generator for insertion and removal of the fuel unit; the access panel can be removable from the remainder of the housing; the access panel can be a hinged panel that remains attached to the remainder of the housing.

[0013] A second embodiment of the disclosure is a fuel cell system including a fuel cell battery and a hydrogen generator as described above. Embodiments can include any of the following, alone or in combination:

- the fuel cell system includes a controller to selectively provide energy to one or more conductor members; each of the one or more conductor members can conduct energy to one or more of a plurality of quantities of the exothermic mixture; the controller can selectively provide energy to one or more conductor members based one or more parameters of the fuel unit, the hydrogen generator and a hydrogen consuming device; and
- the fuel cell system includes an energy source that is external with respect to the fuel unit; the energy source can be external with respect to the hydrogen generator.

[0014] A third embodiment of the disclosure is a method of generating hydrogen gas. The method includes the steps: (a) providing a hydrogen generator including a housing with an access panel, an initiator assembly disposed in the housing and including one or more contact members, a compressible member having opposing first and second surfaces and within which the one or more contact members are disposed, and a fuel unit removably disposed in the housing adjacent the second surface of the compressible member, the fuel unit containing a hydrogen containing material that can release hydrogen gas when heated and an exothermic mixture that can react exothermically upon initiation by energy from the initiator assembly; (b) disposing the fuel unit within the housing; (c) securing the panel to enclose the fuel unit within the housing, thereby pushing the fuel unit against the first surface of the compressible pad to compress the pad and extend ends of the contact members from the surface of the compressible pad to contact the fuel unit; (d) supplying energy to at least one of the contact members and conducting the energy to a corresponding quantity of the exothermic mixture to initiate an exothermic reaction in the quantity of exothermic material; and (e) conducting heat from the exothermic reaction to a corresponding portion of the hydrogen containing material

to cause a release of hydrogen gas. Embodiments can include any of the following, alone or in combination:

- the hydrogen generator includes one or more of the features of the first aspect of the invention disclosed above;
- the fuel unit is removed from the hydrogen generator, and steps (b) through (e) are repeated using another fuel unit;

[0015] These and other features, advantages and objects of the present disclosure will be further understood and appreciated by those skilled in the art by reference to the following specification, claims and appended drawings.

[0016] Unless otherwise specified, the following definitions and methods are used herein:

- "corresponding" means in thermal or electrical communication with;
- an electrical insulator or electrically nonconductive material or structure is a material or structure with poor electrical conductivity, the electrical conductivity at 293°K being less than 10^{-10} $ohm^{-1} \cdot meter^{-1}$;
- a thermally conductive material or structure is a material or structure with good thermal conductivity, the thermal conductivity being greater than 100 watts/meter•Kelvin; and
- a thermal insulator or thermally nonconductive material or structure is a material or structure with poor thermal conductivity, the thermal conductivity being less than 5 watts/meter•Kelvin, preferably less than 2 watt/meter•Kelvin and most preferably less than 1 watt/meter•Kelvin).

[0017] Unless otherwise specified herein, all disclosed characteristics and ranges are as determined at room temperature (20-25°C).

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In the drawings:

FIG. 1 is an exploded perspective view of an embodiment of a hydrogen generator;

FIG. 2 is a perspective view of the hydrogen generator in FIG. 1, with components assembled

into either a top or bottom housing member;

FIG. 3 is a cross-sectional view of the hydrogen generator in FIG. 1, with an open housing

and uncompressed compressible member; and

FIG. 4 is a cross-sectional view of the hydrogen generator in FIG. 1, with a closed housing

and compressed compressible member.

The invention claimed is:

1. A hydrogen generator comprising:

a housing including an access panel;

an initiator assembly disposed in the housing and including one or more contact members;

a compressible member having opposing first and second surfaces and within which the one or more contact members are disposed; and

a fuel unit removably disposed in the housing adjacent the first surface of the compressible member, the fuel unit containing a hydrogen containing material that can release hydrogen gas when heated and an exothermic mixture that can react exothermically upon initiation by energy from the initiator assembly;

wherein:

when no fuel unit is disposed in the hydrogen generator, the compressible member is uncompressed, and the one or more contact members are at or below the first surface;

when a fuel unit is disposed in the hydrogen generator, the compressible member is compressed such that the one or more contact members extend beyond the first surface to make thermal contact with the fuel unit; and

energy from the initiator assembly is conducted by the one or more contact members to corresponding one or more quantities of the exothermic mixture to initiate an exothermic reaction therein, thereby providing heat for the release of hydrogen gas from the hydrogen containing material.

2. The hydrogen generator according to claim 1, the hydrogen generator comprising a plurality of contact members, each corresponding to one or a group of a plurality of segregated quantities of the exothermic mixture.

3. The hydrogen generator according to claim 2, wherein an exothermic reaction in each one or group of the plurality of quantities of the exothermic mixture can be selectively initiated via the corresponding contact member.

4. The hydrogen generator according to claim 1, wherein the initiator assembly comprises one or more heating elements, each in thermal communication with at least one